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A Manager's Guide for Monitoring Data Integrity in Financial Systems

Roger Sies

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[1] At Boulder, CO 80303.
[2] Some elements at Boulder, CO 80303.

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Table of Contents

Introduction 1
Need for Monitoring Financial Systems 2
Monitoring Module Overview 5
Monitoring Module Tools 6

Implementation 7
Data Warehousing 9

Monitoring Tools Must Change as Technology Changes 14

Secondary Uses for Monitoring Tools 15

Documenting the Monitoring Module 16

Appendix A. Description of Monitoring Tools 18
Exception Reporting 20
Data Retrieval and Management Analysis 21
Selecting, Sorting, and Summarizing Data 21
Analysis 22
Field Statistics 22
Frequency Distribution Reporting 22
File or Table Stratification 22
Aging Data 23
Gap Detection and Duplicate Detection 23
Calculated Fields 23
Data Manipulation 23
Join Fields Between Files and Tables 23
Compare/Match Two Files or Tables 24
Exporting Data 24
Monitoring Module Guidelines for Functions/Processes 25

Appendix B. Preventive Controls 44
Edit and Limit Checks 44
Digital Signatures 45

Appendix C. Integrated Test Facility 46

Appendix D. Monitoring Module Tools - Examples and Samples 49

Appendix E. Contributors to the Report 59

Glossary 61

References 64

Introduction 1

The concept of putting a set of automated monitoring tools into accounting systems was first described in NIST Special Publication (SP) 500-226, *Self Monitoring Accounting Systems*[1]. This report, written with the assistance of a work group of financial and system experts (see Appendix E), provides an expanded list of suggested functionality, a more specific description of the individual tools than the original publication, and a guide to implement and use those tools. This guide will enable managers to identify and justify software tools and techniques to include in new or existing financial systems.

Adopting these guidelines would result in a Monitoring Module consisting of software that includes an easy-to-use report generator. Financial and accounting personnel, as well as other system users, could use the Monitoring Module to help ensure input accuracy, completeness, and timeliness. The Monitoring Module would help ensure data consistency across the organization and increase managers' ability to test and report the level of success with which their management goals are being met. If possible, the Monitoring Module discussed in this report should be implemented as a suite of tools built into financial systems and should be considered an integral internal control for financial systems.

It is important to note that most, if not all, of the Monitoring Module discussed in this report can be used in mixed systems as well. A mixed system is an information system that supports both financial and nonfinancial functions. To be effective in improving an organization's data integrity, the module should be included in all financial and mixed systems. The next section describes the need for the Monitoring Module within the Federal government; however, it is important to note that this Module will serve the needs of private industry equally well.

Need for Monitoring Financial Systems

The public is demanding increased accountability for the use of funds by responsible managers. With the increased emphasis being placed on improving government operations and providing meaningful information to multiple levels of users, program and financial managers are expected to make and implement accurate and timely financial decisions. The CFO Act of 1990 (as amended) along with other recent legislation covering the financial accountability of the Federal government, has significantly increased Federal agency requirements for collecting, maintaining, and reporting accurate and comprehensive financial data on agency programs, operations, and resources. Requirements for system internal controls - both general and specific to the application - have increased in importance as well. These trends mirror similar developments in the private sector and at the state and local levels.

In the Federal sector, the Joint Financial Management Improvement Program (JFMIP) has developed the *Framework for Federal Financial Management Systems* [2], with subsidiary sets of requirements for selected financial system modules (core, travel, payroll, budget, etc.). These requirements are meant to help program and financial managers establish and maintain financial management systems to support managers and Federal government delivery programs (see Figure 1).

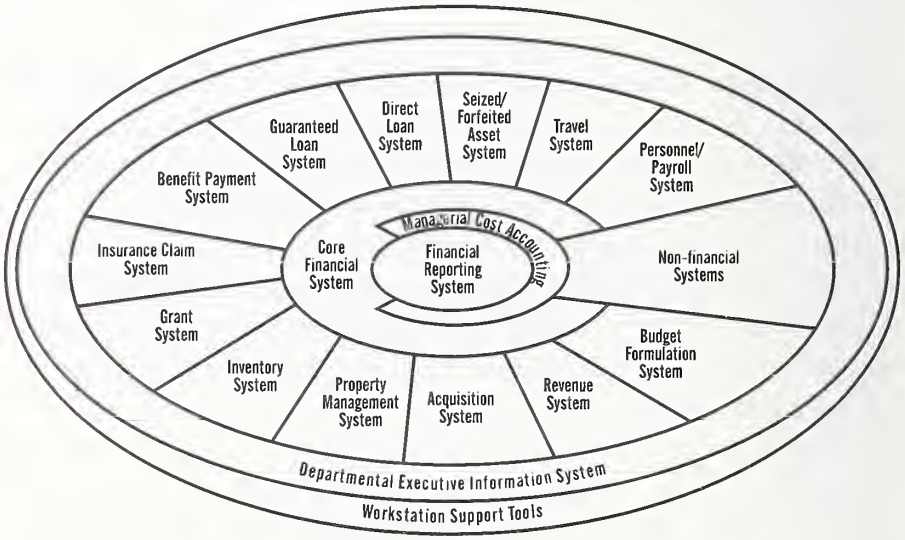
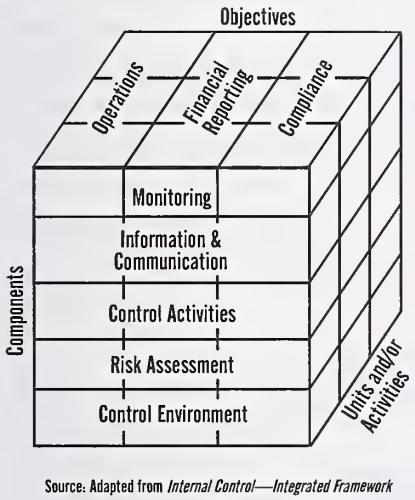


Figure 1. Agency Systems Architecture, which provides a logical perspective identifying the relationships of various agency system types. From JFMIP's Framework for Federal Financial Management Systems.

Recognizing the need for good financial management information and supporting systems, the CFO Council adopted the following vision for financial management in the spring of 1994:

Enabling government to work better and cost less requires program and financial managers, working in partnership using modern management techniques and integrated financial management systems, to ensure the integrity of information, make decisions, and measure performance to achieve desirable outcomes and real cost effectiveness.

Both the JFMIP framework and the private-sector-based Committee of Sponsoring Organizations of the Treadway Commission (COSO) *Model Framework for Internal Controls* present monitoring capabilities as integral to financial management systems frameworks (see Figure 2).



Source: Adapted from *Internal Control—Integrated Framework*

Figure 2. Relationship of Internal Control Objectives and Components.

In an environment where most financial transactions are automated, there may be no "paper trail." Furthermore, implementation of highly automated financial systems may expose organizations to increased risks of waste, fraud, and abuse if system controls fail to be effective. It is imperative, therefore, that automated monitoring capabilities as sophisticated as the automated financial operations themselves be available to financial managers.

With the use of effective techniques and user-friendly tools, an automated monitoring module for automated financial management systems can be designed, implemented, and operated within the constraints of budget austerity and downsizing. The techniques described in this guide focus on establishing an "expected" experience in financial operations and on analyzing those circumstances that deviate from these expectations. These techniques also permit the financial manager to readily identify exceptional transactions, spot trends, and identify problem areas early enough for effective preventive action.

With the automated monitoring tools described in this guide, the financial manager can improve data integrity by evaluating the effectiveness of existing controls and by continually testing processing accuracy and validity. It is hoped that financial managers will pursue the implementation of such a monitoring module as part of an overall effort to improve financial management in the public and private sectors (see Figure 3).

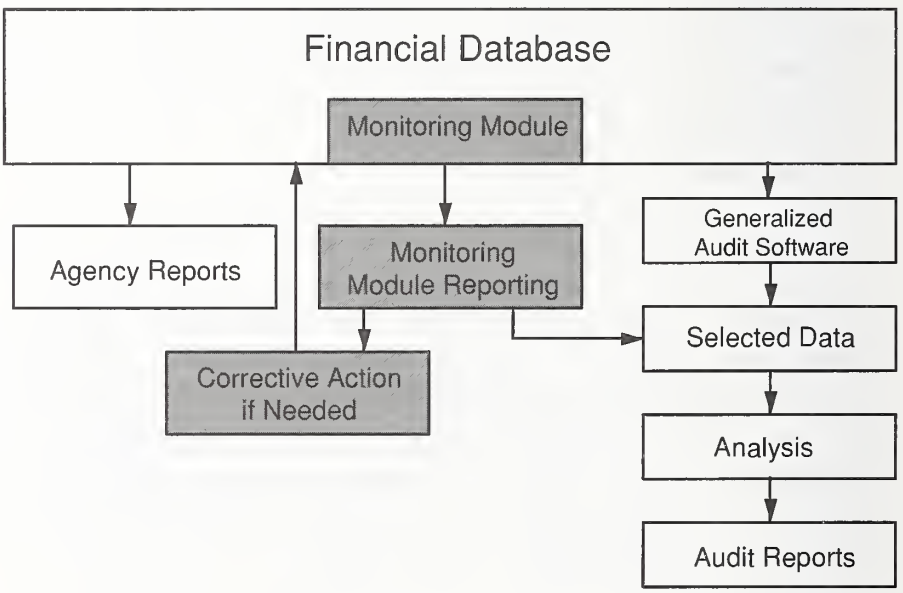


Figure 3. The unshaded blocks represent the use of generalized audit software with a financial system. The shaded areas show the Monitoring Module added.

Monitoring Module Overview

Rather than waiting until auditors tell them where problems exist, managers should have the ability to find and correct problems as they occur. New accounting systems can provide preventive controls, such as data verification and edit checking as data are entered (see Appendix B). These tests greatly improve the quality of information and should be considered the first level of defense against errors in any good financial system. Documentation should be available that describes in detail the tests performed on data being entered into the system. These tests, along with all other internal controls, should be evaluated periodically. One method of evaluating these tests is an Integrated Test Facility (see Appendix C).

The most desirable point to detect and correct errors is before the data are entered into the system. As this is not always possible, the Monitoring Module tools are a good next line of defense. After clearing the preventive controls, data involved in multiple transactions, such as incurring and paying a liability, must be compared for consistency. In addition, there are transactions falling within an acceptable range that still must be reviewed by management after they are in the system; for example, valid transactions over a designated dollar threshold.

Such capabilities should be included in the Monitoring Module as a set of reports generated by queries to the data in the system. These reports should give the manager some of the capability that auditors have to analyze data through the use of Generalized Audit Software. (A detailed discussion of the use of Generalized Audit Software to perform data integrity testing is included in the Information Systems Audit and Control Foundation's *Computerized Information Systems (CIS) Audit Manual.* [3]) These kinds of capabilities should be included in accounting systems, allowing management to perform analysis that will be described in detail below. Such analysis would enable managers to find discrepancies in accounts and transactions soon after they occur.

The Monitoring Module could include functionality that allows for an information store of applicable rules, regulations, accounting policies, and laws that can be compared to transactions. This information store would be used for edit and limit checks and for reports to management on discrepancies found in the records. The store could also contain information regarding management's goals. The Monitoring Module could then test and report to management the level of success with which these goals are being met. Expert systems, as well as other software solutions, could provide this functionality.

The set of suggested Monitoring Module automated tools is listed below and discussed in Appendix A. The software tools from the list will change over time as computer technology evolves.

Monitoring Module Tools

- Exception Reporting
- Data Retrieval and Management Analysis

  Selecting, Sorting, and Summarizing Data

  Analysis

    Field Statistics
    Frequency Distribution Reporting
    File or Table Stratification
    Aging Data
    Gap Detection and Duplicate Detection
    Calculated Fields

  Data Manipulation

    Join Fields Between Files and Tables
    Compare/Match Two Files or Tables

  Exporting Data

Implementation 2

All Monitoring Module tools should be as automated as possible. Exception reporting, including choosing proper criteria and report design, should be set up by the manager or a vendor as part of the implementation process. Management would then need to review the criteria periodically and make required changes. Manual intervention would be needed to select the tool for use and, possibly, to enter information needed to perform the function. These tools should be as easy to use as possible. For example, there are two review methods available to the user:

- The system prompts the user for the statistical precision, prompts for the reliability desired, and then calculates the sample size and selects the records after user approval

- The system prompts the user for the criteria to use in direct record selection

This section is intended as guidance for management decisions made within the framework of individual accounting systems. Implementation decisions should be made by management with the help of its internal audit organization. The cost of accounting errors within the organization and the cost of implementing these monitoring tools should be considered in making these decisions. It should be noted that the costs of errors are long term and are often difficult to quantify. Incorrect accounting information can lead to loss of assets and faulty management decisions. The consequences of faulty decisions may not immediately be apparent, and the resulting problems and their attendant costs may not be traced to the incorrect accounting information that was used to make the decisions. System vendors should be able to provide cost estimates for implementation, and internal audit organizations should be able to estimate the costs of incorrect financial information.

General systems categories include off-the-shelf systems, modified off-the-shelf systems, and custom-built systems. Within these categories are systems built with relational database technology and systems built with more traditional technology such as COBOL, C, or some other programming language. Systems are currently being implemented in all of these categories. Implementation of the Monitoring Module tools should be straightforward and inexpensive. For instance, it should be easy to add many of these tools to the systems currently being implemented with relational database technology. Older COBOL systems may be more difficult; the best approach may be to take generalized audit software from a commercial vendor and add it to the system in the same way an auditor would.

It is important that the tools be integrated into the system as a module. A facile user interface should present the Module to the user and the user should be able to choose the desired tool from a list. There should be on-line descriptions and examples of the tools. For new systems built using relational database technology, implementing most of these tools is a matter of creating new reports and fill-in screens that allow the user to enter information used to automatically create queries. Additional programming will be needed for some capabilities such as statistical sampling. This programming should be minor and should not add greatly to the cost of the system.

The best approach for existing systems that are not implemented with relational database technology may be an off-the-shelf generalized audit software package. A system designer may be able to add menus to make this software appear more integrated with the financial system. Existing systems that use relational database technology allow easier development of a standardized interface to the Monitoring Module. This idea is emphasized in Federal Information Processing Standards Publication 193, *SQL Environments* [4], which recommends that legacy and special purpose databases could present a simple relational interface to tools such as the Monitoring Module. Such interfaces could be procured separately and added to legacy systems. Management must understand and be involved in the implementation of these tools.

The key to effective monitoring tools is to include their implementation as a stated goal in the financial system implementation plan. If this goal is not included, there may be resistance to completing what others may see as a luxury. If you are adding software monitoring tools to an existing system, define a project and set of tasks that will also lead to successful implementation. Make your implementation goals concrete, discrete, and achievable within a short time frame. This approach will increase the probability that your organization can start to evaluate the validity of system data before staff or other resources are re-allocated to another project.

Data Warehousing

Your organization may decide to load the data on a computer other than the one on which the financial system resides. This approach is often chosen when performance (throughput or response time) or security concerns mandate choosing another repository for the data. Data warehousing, whereby data are placed on a computer distinct from the computer being used to process the data, is coming into increasing use. These data are then "mined" to select and report information deemed significant. Although creating a separate system for data processing presents its own set of challenges, e.g., coordinating the timing of copying data to the remote system, a data warehouse often provides advantages that cannot be achieved through use of the production financial system computer platform.

Regardless of the implementation approach elected, the Monitoring Module should be considered integral to the organization's overall financial system architecture. The Monitoring Module should fit between the high level executive information system and day-to-day control activities, as shown in Figure 1.

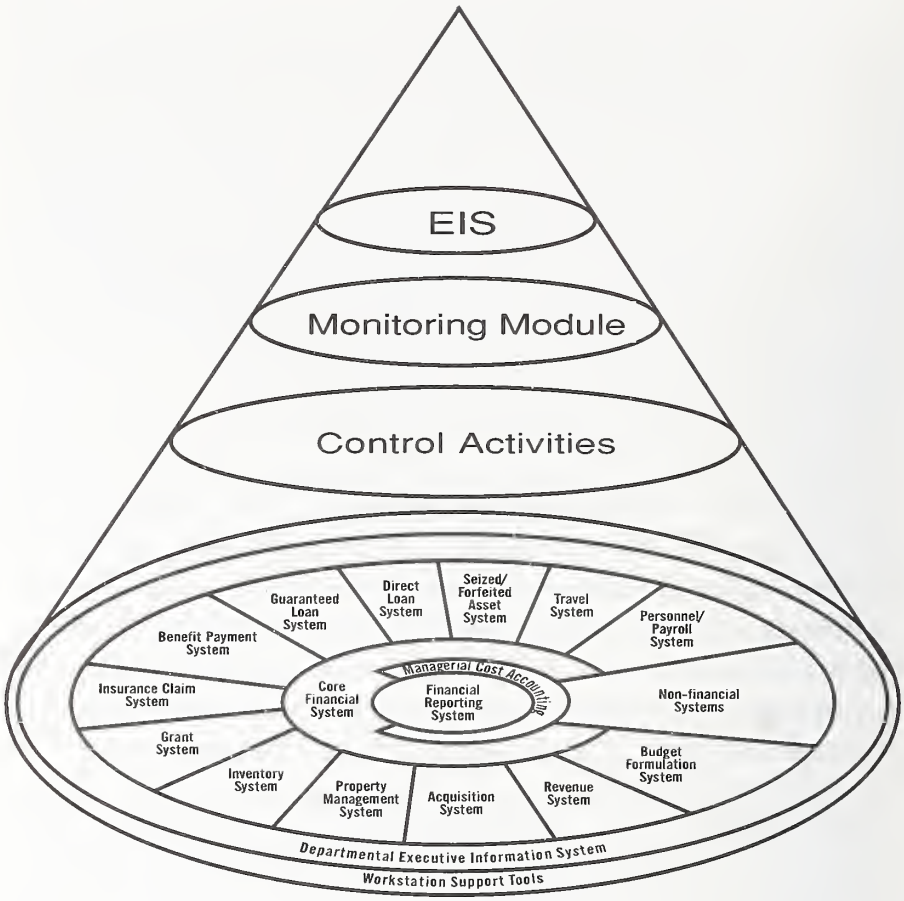


Figure 1. The JFMIP Agency Systems Architecture with the Monitoring Module, Control Activities, and Executive Information System (EIS).

The financial systems architecture illustrated in Figure 1 represents a blending of the JFMIP framework model for financial systems with the COSO model for internal control as a suggested approach for implementing the Monitoring Module.

Existing computer standards should be used when possible. Two such standards that can be useful in implementing the Monitoring Module are the Federal Information Processing Standards Publication 193,*SQL Environments,* and the *Database Language (SQL)* [5] standards.

Every item in the list on page 6 should have a menu selection associated with it in the overall Monitoring Module menu. Associated with each of these menu selections should be the software programming for performing the function. The following set of figures (2-6) demonstrate how a user interface for the Monitoring Module might look. This set is neither intended nor detailed enough to be an actual user interface.

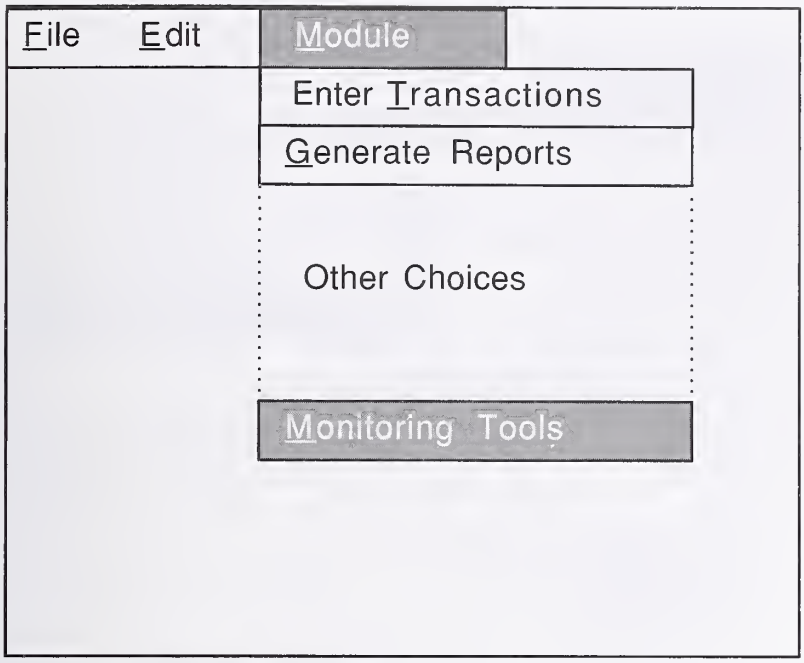


Figure 2 shows the Monitoring Module being selected from the available accounting system functions.

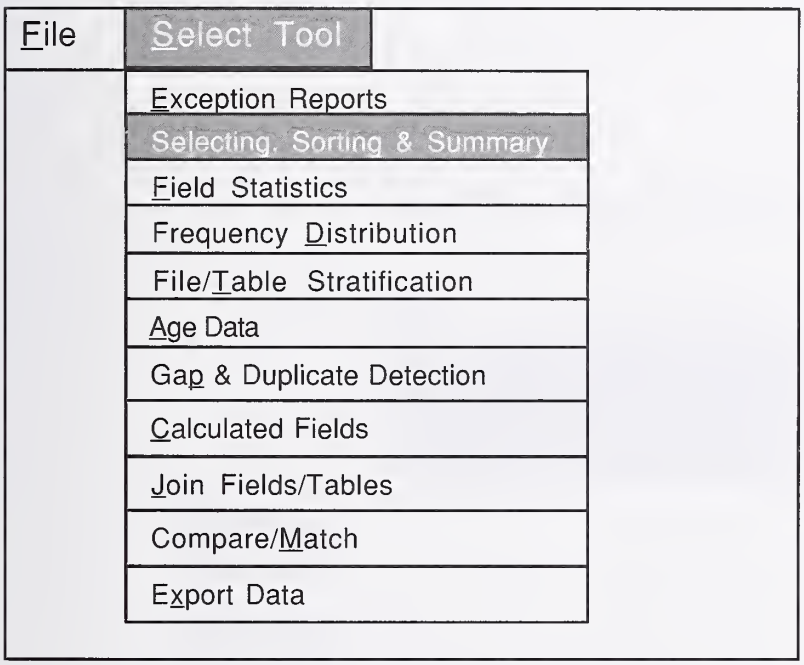


Figure 3 shows the Selecting, Sorting, and Summary Tool being selected.

Figure 4 shows the Payment Management cycle being selected to use in conjunction with the Selecting, Sorting and Summary Tool.

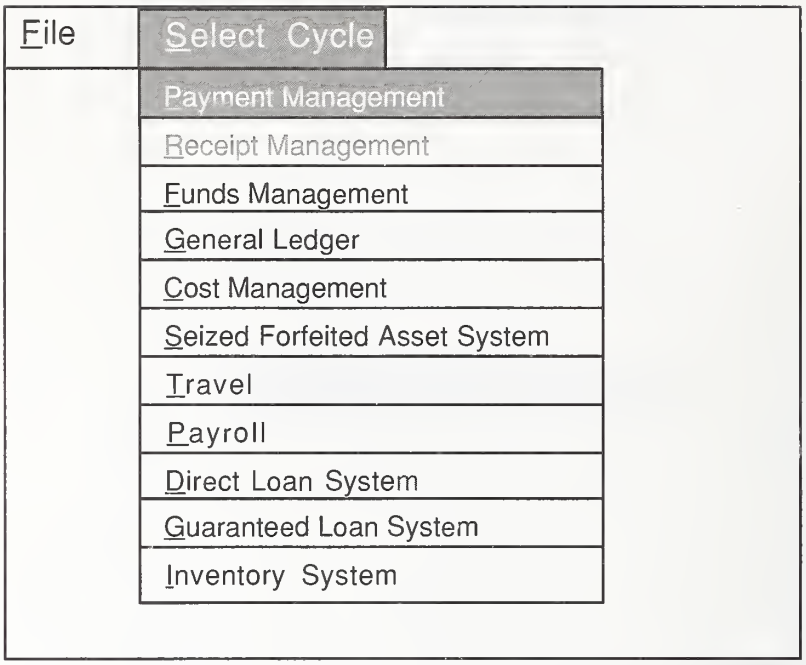
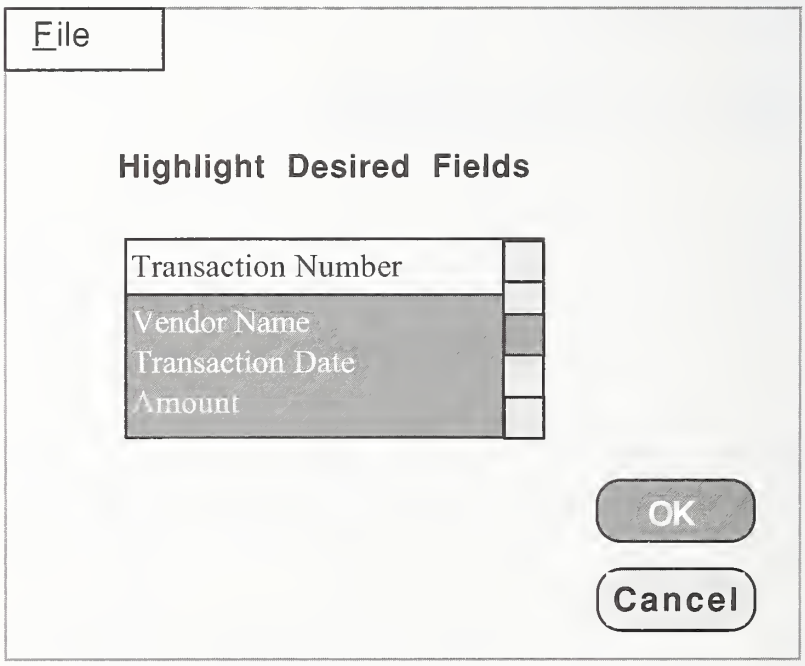


Figure 5 shows the desired payment management file fields being selected for inclusion in the analysis.



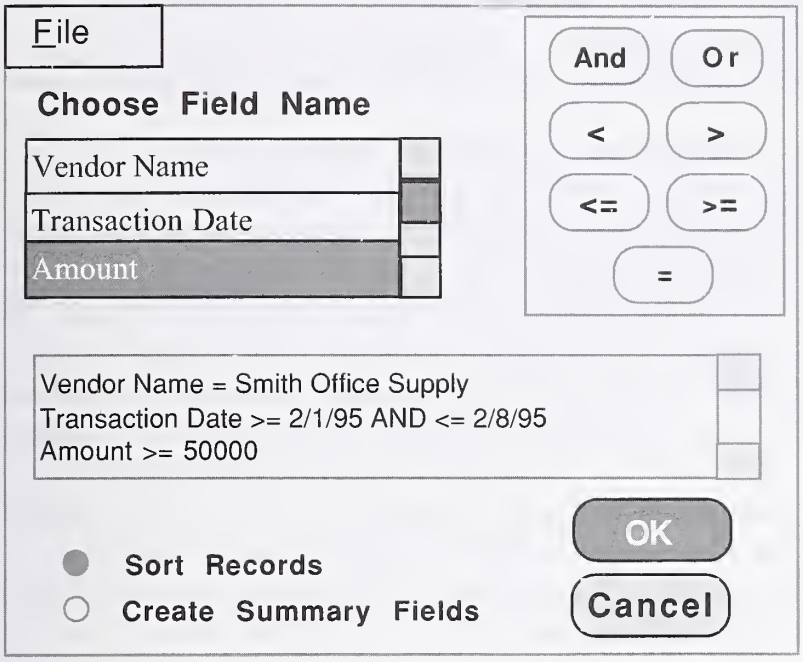


Figure 6
demonstrates how the query would be developed. If "Sort Records" or "Create Summary Fields" is selected, additional screens are provided to allow the user to provide the additional information needed.

Monitoring Tools Must Change as Technology Changes 3

Accounting systems and the underlying technology will change over time as advances occur, enabling corresponding changes in the Monitoring Module. Accounting systems are likely to become more distributed, and technology such as Electronic Commerce and Electronic Data Interchange, more prevalent. Data will be entered from both across and outside the organization. Technology such as digital signatures (see Appendix B) will be needed in financial systems to allow authentication of transactions that come into the accounting system from an outside source. Digital signatures can also be used to determine that proper segregation of duties is in place. Tools must be added to the Monitoring Module to verify that new technology is performing as expected in preventing unauthorized entry or incorrect data into the financial system.

The set of tools recommended for inclusion in financial systems will change as the financial system technology changes. New or soon to be available tools must be considered for inclusion in a set of monitoring tools. An example of such a tool is profiling, the detection of deviations in behavior. An example of a profiling application is monitoring and verifying phone calls made on a phone charge card. Patterns of charged calls are formed and stored in a user profile. This profile is then used to match against subsequent calls made by the user. If any unusual patterns are detected, such as calling long distance more frequently than usual or calling overseas, the user is notified to verify authorization. Profiling is also being used in the health care industry. Profiles compiled for patients contain such information as frequency of visits, types of treatments, insurance information, and payment information. These profiles could be used to identify such unusual patterns as more than the usual treatments, treatments for conditions that have already been treated, and unusually high billings.

Secondary Uses for Monitoring Tools 4

Both government and private sector managers are often asked to put financial information together quickly for concise presentations. Congress frequently requests information from Federal agencies. New results-oriented initiatives such as the Government Performance and Results Act (GPRA) will increase these demands, and the information required will be more complex and difficult to obtain. GPRA shifts the focus from program inputs to results and to how well the programs are meeting their intended objectives.

Organizations today need information reported quickly. They must draw from more complex and elusive data stored at more than one location in the organization. In addition, they must develop more flexible reporting capabilities. The tools discussed in this report will provide the user with powerful, flexible ad hoc reporting capabilities useful in responding to these information requirements.

Documenting the Monitoring Module 5

Documentation for the entire accounting system should be consistent with computer standards and good software engineering practices. The Monitoring Module should be included in such documentation. The Institute of Electrical and Electronics Engineers, Inc., list the following minimum quality assurance requirements for documentation in their *Software Engineering Standards* [6]:

- Software Requirements Specification,
- Software Design Description,
- Software Verification and Validation Plan,
- Software Verification and Validation Report, and
- User Documentation.

The National Bureau of Standards (now National Institute of Standards and Technology) Special Publication, *Guide to Auditing for Controls and Security: A System Development Life Cycle Approach* [7], is another good source for documentation guidelines.

Good documentation is essential for safeguarding system investments. Good documentation allows for easier system maintenance and facilitates system modification. User documentation helps ensure proper system use and lower personnel training costs.

In addition to the uses listed above, a complete set of documentation allows auditors to make an initial assessment of the internal controls provided by the Monitoring Module. This may serve to lower both costs and time spent on auditing the system.

Monitoring Module user documentation should be one cohesive section of the system documentation for easy access. This documentation should also be built into the system in the form of on-line help. It should include complete information about the tools, including criteria for selecting data and exception reporting. The documentation should have enough information regarding each tool to inform the user of what information must be entered to produce the desired effect. Tool descriptions should include the purpose of each tool and should outline the tests and analyses management might wish to perform. Finally, each report created by the Module should contain the parameters used in creating the report.

Appendix A. Description of Monitoring Tools 6

This section suggests tools that might be included in the Monitoring Module. These tools can be generalized for use in mixed systems as well as pure financial systems. Although there are a few examples for mixed systems, most of the examples in this report are found in pure financial systems. Management must make the final decision about which tools to include in its systems. This decision should be made with advice from the internal auditors who perform system audits, and the manager should take implementation costs into account. However, any consideration of implementation costs should include the potential for long-term, substantial cost savings to be derived from better control over assets and more accurate provision of data.

None of the capabilities discussed in the section are new, nor is the idea of giving this functionality to accountants and managers. What is new is the approach: Putting organized sets of software routines into accounting systems to perform these functions. The Systems Auditability and Control Report from the Institute of Internal Auditors Research Foundation points out that preventive, detective, and corrective controls tend to operate in combination, either with or without dependencies. Cost-effectiveness is a key element in the use of preventive, detective, and corrective controls. Some errors may result in grave consequences and must be prevented if at all possible. Other errors may be costly to prevent, but easy to detect and correct. Other errors or problems may be impossible to predict or prevent, but must be acknowledged so that appropriate recovery or corrective controls can be employed.

Some control techniques may be classified as preventive, detective, or corrective depending on where or how they are used in a process or system. Some considerations in the classification and combinations of these control types follow.

Preventive Controls keep undesirable events from occurring. In an information systems (IS) environment, preventive controls are accomplished by implementing automated procedures to prohibit

unauthorized system access and to force appropriate and consistent action by users. Because preventive controls are unlikely to be 100 percent effective, they should operate in combination with detective controls, which identify errors or events that were not prevented. It may not be cost-effective to prevent all errors at the source, and complementary detective controls may be used as a measure to prevent the error from being carried through the system.

Detective controls identify undesirable events after they have occurred. Detective controls have the following two components:

- The system should identify and record user activity, key transactions, and unusual conditions in exception and summary reports to ensure a thorough and accurate audit trail.

- A management hierarchy should be in place to review the exception and summary reports. Identify any abnormalities, and take appropriate action.

Detective controls should identify expected error types, as well as those that are not expected to occur.

Corrective controls cause or encourage a desirable event or corrective action to occur after an undesirable event has been detected. This type of control takes effect after the undesirable event has occurred and attempts to reverse the error or correct the mistake. [8]

The tools suggested for the Monitoring Module fit into the detective control category. Other technology, such as edit and limit checks and digital signatures, fit into the preventive control category. Preventive controls are discussed in Appendix B.

Exception Reporting

Catching errors before the data are entered into the system is the most desirable method for discovering and correcting problems, but this is not always possible. The use of exception reporting can be the next line of defense against erroneous data.

Criteria used to identify exceptions are designed to address specific areas with predictable problems. These criteria are more or less stable but should be reviewed to reflect trends uncovered by other monitoring tools. Criteria will often need to be tailored to specific parts of the organization. The user interface should allow authorized personnel to change these criteria with relative ease.

There may be more than one way to handle the data that do not pass the pre-defined criteria: suspend the data (transaction) from further processing and post the data to a suspense file; forward the data to another system user for resolution; ask the person entering the data to modify the data to make it acceptable; or print the data onto an exception report for distribution within the organization. One or all of these methods can be used in a financial management system. Whatever the method used, it is important to identify the exception, and to report that exception to appropriate authorities, and to ensure that the exception is appropriately and efficiently resolved. Some systems will accept a transaction (data) and send a notification to another system user, such as a manager or director, notifying that user that an exception has occurred that requires follow-up. Others will send electronic mail messages to authorized users notifying them of the exception and requesting exception resolution. Others still will send the data or transaction to authorized users and request that user's approval on the data (transaction) to allow for further processing to take place.

The essential components of a well-designed monitoring capability include the ability to identify data that do not meet pre-defined criteria, report the situation of possible non-compliance, and have another individual with authority approve or reject the data for further system processing.

Data Retrieval and Management Analysis

Some of the functions performed by data retrieval and management analysis are as follows:

- Selecting, sorting, and summarizing data
- Field statistics and frequency distribution
- File or table stratification, and aging data
- Gap and duplicate record detection
- Calculated fields
- Joining and comparing fields between files or tables
- Exporting data

Selecting, Sorting, and Summarizing Data

This tool should be used to generate ad hoc reports to supplement predesigned exception reporting, allowing management to select groups of records from files or tables based on various sets of criteria. All records from a file or table can be selected, or a subset of the records can be selected based on specific criteria or on a statistical sample. For example, all accounts payable transactions for a particular vendor could be selected by performing a query of all the records whose vendor field is equal to the name of that particular vendor. This selection could be made more selective, and perhaps more useful, by asking for only those vendor records for a specific time (e.g., January 1 through January 31).

Selected records can appear in several different sequences. They can be in the order the computer system normally stores data. They can be reordered or sorted alphabetically or numerically within one or more fields in ascending or descending order. They could also be presented randomly. A sort on one field might be the accounts payable transaction file by vendor name. A two field sort, by vendor and then by date, might be more useful. It might be even more useful to have the file sorted by date first and then by vendor name within each date. All records could be selected for a particular vendor, sorted by date, and then sorted by dollar value within each date.

Once records are selected and sorted, they can be summarized. For example, the accounts payable transactions can be sorted by vendor and totaled or summarized for each vendor and for the entire file or table. The records could also be selected for one vendor, sorted by date, and totaled by groups of dates and by transactions for that vendor.

Some of the reports created with this tool may be similar to exception reporting described above. The distinction for the purpose of this report is that exception reports are predesigned reports whereas reports created by selecting, sorting, and summarizing data are ad hoc reports. Exception reports can and should be changed periodically, but their purpose is to identify problems that can be expected to occur frequently or routinely. Ad hoc reports are designed to identify candidates for new exception reports and specific problems that occur infrequently or sporadically

Analysis

Field Statistics. Enables the user to obtain statistics on numeric fields within a file or table. This capability differs from file or table summarization in that only the summary information is reported. Various information can be developed including sums; average, minimum, and maximum values; and standard deviation information.

Frequency Distribution Reporting. Allows management to obtain a quantitative overview of how data categories arrange themselves within different populations. For example, frequency distribution reporting can be used to verify the valid codes for a field and to identify erroneous data. Totals and other important information can be provided, including mean and standard deviation, in tabular or graphical format.

File or Table Stratification. Provides managers with a clear perspective on the contents of a file or table. This tool can help a manager determine what other methods should be used and how much time should be spent in testing the file or table. Monetary bands are created and records are arranged into the bands to which they belong. The user should be able to specify a number of ranges and obtain totals and percentages for records within those ranges. For example, the manager may want to determine how the file or table divides into segments based on the dollar amount of the transactions.

Stratification differs from frequency distribution in that in stratification the user defines the data categories and in frequency distribution the natural arrangement of data categories is reported.

Aging Data. Accounts receivable and payable can be aged to determine the timeliness of processing and, in the case of receivables, how likely the receipt of payment is. This capability is usually provided in financial systems. However, it is often useful to age other files as well. For example, it may be useful to age unposted collections data.

Gap Detection and Duplicate Detection. Gaps and duplication should be eliminated with automatically generated numbers in new systems. If this is not possible or is too expensive to implement, a detection capability can test data files for missing or duplicate records. Duplicate and missing records can be identified in sequenced records such as checks or invoice numbers. Sorting can be used to detect record duplication if sequential numbers are not used.

Calculated Fields. Provides the ability to perform any calculation on any field or fields. For example, amounts claimed on travel vouchers can be recalculated and compared to established limits. Another example is to perform extensions on vouchers and invoices.

Join Fields Between Files and Tables. This capability is useful when the desired data reside in multiple files or tables. If the data reside in two or more files or tables whose records have the same key fields, the records can be joined to allow the user to see more complete information. For example, a report can be generated using an inventory file and a sales file to show sales activity by part or stock number.

Compare/Match Two Files or Tables. Check for conflicts or matches between two different files or tables that contain related or equivalent information.

The following are examples of files or table matching:

- Changes in accounts receivable balances between two dates compared with details of sales and cash receipts on transactions files
- Payroll details compared with personnel records
- Current inventory files compared with prior-period inventory files to identify obsolete or slow-moving items.

Exporting Data

Spreadsheets, graphical packages, and databases expedite data analysis. These software packages can help management discover errors in data and analyze data from different perspectives. Creating ad hoc reports with some systems can be challenging for people without experience. It may be easier to bring the data into a spreadsheet or a database the user is familiar with and then perform the analysis.

The following tables provide monitoring module guidelines. They are organized by function and processes in accordance with the JFMIP Core Financial System Requirements [9]. The samples provide suggestions for using monitoring techniques and tools for specific data integrity objectives. The samples are not intended to represent a complete set of monitoring objectives, techniques, or tools.

Monitoring Module Guidelines for Functions/Processes

Payment Management - Payee Information Maintenance

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Information on all payees are accurately reflected in the payment information database.	Reconcile payee information on invoices with information in the database.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
	Identify changes to payment management files for supervisory review, e.g., new suppliers, changes in payment instructions, changes in pricing.	Exception Reporting

Payment Management - Payment Warehousing

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Payments warehoused and scheduled payments are maintained in accordance with contract terms, loan/grant agreement, applicable regulations, etc.	Identify payments that are not warehoused and scheduled to accordance with contract terms, loan/grant agreement, etc.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
	Analyze automated records on contracts, invoices, and receiving reports to determine compliance with contract terms and applicable regulations.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data

Payment Management - Payment Warehousing Continued

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Payments are both timely and accurate.	Obtain summary information on number and dollar value of payables over 60 days old, 90 days old, etc.	Selecting, Sorting, and Summarizing Data
	Obtain summary information on Prompt Payment Act Compliance (e.g., late payments, missed discounts, etc.).	Selecting, Sorting, and Summarizing Data
	Identify any payable with no scheduled payment date.	Exception Reporting
	Identify any payment with a debit balance.	Exception Reporting
	Recalculate payments of interest and penalties on late payments to ensure proper computations.	Selecting, Sorting, and Summarizing Data and Calculated Fields
	Obtain summary data on goods received not invoiced, goods invoiced but not received, or discrepancies between purchase orders, receiving documents, and supplier invoices.	Exception Reporting
	Identify payables established after year-end where receipt occurred in the previous month (to support establishing year-end-accrual).	Selecting, Sorting, and Summarizing Data

Payment Management - Payment Warehousing Continued

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Goods and services paid for represent those actually ordered and received.	Identify instances of goods received not invoiced, goods invoiced but not received,or discrepancies between purchase orders, receiving documents and supplier invoices.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
Goods and services received are paid for only once and at the agreed upon price.	Identify payments made to one vendor in the same amount (potential duplicate payment).	Selecting, Sorting, and Summarizing Data and Duplicate Detection
	Identify gaps in check numbers or other transaction or document numbers.	Gap Detection
	Identify duplicate transactions or document numbers.	Duplicate Detection
Recorded accrued liability based upon receipt and acceptance of goods and services agree with authorized payment.	Reconcile authorized payment (based on the invoice) to the amount accrued (based upon receipt and acceptance).	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
Funds control and budget execution balances reflect changes in the status of undelivered orders, expended status of undelivered orders, expended appropriations, and changes in amounts.	Determine extent of discrepancies in the funds control/budget execution balances and the status of undelivered orders, expended appropriations, and amounts.	Selecting, Sorting, and Summarizing Data

Payment Management - Payment Execution

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Payments authorized in accordance with applicable laws, regulations and managements policy.	Determine extent of payments made without, or coincident with, establishment of an obligation.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
Obligations and expenditures do not exceed amount authorized and available.	Determine extent of over obligations and over expenditures.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
Payments made by another system (e.g., payroll) are scheduled for the core financial system.	Summarize payments made by another system by due date, vendor name, etc.	Selecting, Sorting, and Summarizing Data
	Reconcile payments made by another system with records in the core financial system.	Compare/Match Files or Tables
Payments are made to the appropriate parties.	Compare identification numbers on checks and transfers to invoices.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
Payments are made appropriately.	Identify aberrancies by employees related to authorizations, obligations, and payments.	Selecting, Sorting, and Summarizing Data
	Identify all payments made by a particular employee.	Selecting, Sorting, and Summarizing Data
	Identify gaps in check numbers.	Exception Reporting

Payment Management - Payment Confirmation and Follow-Up

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Payments were received and recognized by parties paid.	Compare actual payments to remittance advice.	Selecting, Sorting, and Summarizing Data
	Identify payments that have been outstanding for an extended period.	Exception Reporting

Receipts Management - Receivables Establishment

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Changes to customer credit limits and unusual discounts are reviewed by management.	Identify for supervisory review invoices that contain unusual prices or discounts.	Selecting, Sorting, and Summarizing Data
	Identify for supervisory review changes to customer credit limits.	Compare/Match Files or Tables
Receivables are accurately recorded by amount, type, and period.	Match shipment dates with invoice dates to identify revenue and receivables booked in the wrong accounting period.	Join Fields between Files and Tables and Selecting, Sorting and Summarizing Data
	Identify entities for which new receivables are established, when they are already delinquent on other payments.	Selecting, Sorting, and Summarizing Data and Compare/Match Files or Tables
	Sort and summarize newly established receivables by type (shipments, service, overpayments, sustained audit findings, Federal, public, etc).	Selecting, Sorting, and Summarizing Data
	Obtain statistical data such as total number of invoices processed, average invoice amount, number of invoices under $X dollars, sales by type/product, etc. Develop above statistics by month to identify trends and peaks and valleys.	Selecting, Sorting, and Summarizing Data

Receipts Management - Receivables Management

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Accounts with credit balances or large adjustments are identified and investigated.	Identify receivables with credit balances.	Exception Reporting
	Identify large adjustments to receivables balances for supervisory review.	Compare/Match Files or Tables and Selecting, Sorting, and Summarizing Data
Receivables are accurately aged and summarized for follow-up.	Obtain receivables aging data.	Aging Data
	Match dates of goods returned and crediting of receivables to ensure posting to the correct accounting period.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
	Summarize large or old suspense items.	Exception Reporting and Aging Data
	Identify receivables with no activity over 90 days, 120 days, 180 days, etc.	Selecting, Sorting, and Summarizing Data
	Identify instances where collection events do not comply with Debt Collection Act (invoicing, interest accruals, penalties and administrative charges, credit reporting, IRS offsets, etc).	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
	Obtain statistical data such as total returns, total adjustments, average receivable amounts, average interest rates, breakdown of receivables by dollar range, etc.	Selecting, Sorting, and Summarizing Data

Receipts Management - Collections

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
All collections are posted accurately, completely, and in a timely manner.	Obtain summary aging data on unposted collections.	Exception Reporting
	Obtain receivable and payment history for a particular entity.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
	Obtain statistical data such as monthly collections, average collection amount, payment method, lapsed time between collections and postings, etc.	Selecting, Sorting, and Summarizing Data
	Provide trend data such as receivable turnover ratio and number of days of receivables.	Selecting, Sorting, and Summarizing Data and Calculated Fields

Funds Management - Funds Allocation

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Funds are allocated in accordance with regulatory restrictions.	Identify any instances where apportionments exceed appropriations, allotments exceed apportionments, commitments exceed allotments, etc.	Exception Reporting

Funds Management - Funds Control

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
All fund activity is properly aged.	Provide aging of open commitments and obligations.	Aging Data
	Provide aging of transactions in suspense.	Exception Reporting
	Identify commitments and obligations with no activity for over 90 days, 120 days, 180 days, etc.	Selecting, Sorting, and Summarizing Data
Fund activity for large amounts is identified and followed up.	Identify commitments and obligations with large balances.	Selecting, Sorting, and Summarizing Data
Payments are made only for funds obligated.	Summarize number of payments made without, or coincident with, establishment of an obligation.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
	Obtain statistical data such as commitments and obligations by type, monthly amount, average amounts, total decommitments/deobligations, etc. Provide data by month to identify trends and peaks and valleys.	Selecting, Sorting, and Summarizing Data

General Ledger Management - Posting

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
High dollar, unusual items and suspense items are identified and summarized for follow-up.	Identify high dollar/unusual postings.	Selecting, Sorting, and Summarizing Data
	Summarize suspense items.	Exception Reporting
All account activity is accurately posted to the general ledger.	Obtain detailed transaction data to support audit and review.	Selecting, Sorting, and Summarizing Data and Exporting Data

General Ledger Management - Accruals, Closing, and Consolidation

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
All general ledger accruals, eliminations, and summarizations are identified and posted.	List eliminating entries.	Selecting, Sorting, and Summarizing Data
	Summarize year-end accruals and compare to prior year accruals to determine reasonableness.	Selecting, Sorting, and Summarizing Data and Compare/Match Files or Tables

General Ledger Management - Analysis and Reconciliation

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Subsidiary ledgers should support general ledger balances.	Identify differences between general ledger and subsidiary accounts.	Selecting, Sorting, and Summarizing Data
All unusual activity such as unnatural account balances or trial balances that are out-of-balance are identified and investigated.	Identify accounts with unnatural balances (assets with credit balances, liabilities with debt balances, etc.).	Exception Reporting
	Identify unbalanced trial balances.	Exception Reporting
	Obtain trend data between years for individual accounts and groups of accounts.	Selecting, Sorting, and Summarizing Data and Compare/Match Files
	Provide ratio data such as inventory turnover ratio, working capital ratio, receivable turnover ratio, number of days of receivables, fixed asset turnover, profit margin on sales, etc.	Selecting, Sorting, and Summarizing Data and Calculated Fields

Cost Management - Cost Recognition and Accumulation

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Large and suspensed cost transactions are identified and investigated.	Identify large or unusual costs.	Selecting, Sorting, and Summarizing Data
	Obtain aging data on cost transactions in suspense.	Exception Reporting
All data from feeder cost systems are accurately reflected in the cost systems accumulation.	Identify differences between cost system data and data obtained from feeder systems (e.g., labor distribution, purchases, depreciation expenses, overhead expense items).	Selecting, Sorting, and Summarizing Data and Compare/Match Files
	Obtain summary data on cost by type.	Selecting, Sorting, and Summarizing Data

Cost Management - Cost Distribution

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Costs are distributed accurately and monitored though periodic analysis.	Identify changes made to standard costs.	Compare/Match Files or Tables and Selecting, Sorting, and Summarizing Data
	Compare standard costs, variances, and actual costs between accounting periods.	Join Fields between Files or Tables and Selecting, Sorting, and Summarizing Data and Compare/Match Files
	Compare production volumes between accounting periods.	Join Fields between Files or Tables and Selecting, Sorting, and Summarizing Data and Compare/Match Files
	Recompute accumulation of component costs to ensure accurate accumulation of standard cost data.	Selecting, Sorting, and Summarizing Data and Calculated Fields or Exporting Data
	Recompute mathematical accuracy of variable analysis and overhead allocations.	Selecting, Sorting, and Summarizing Data and Calculated Fields or Exporting Data
	Compare inventory quantities with production volume to facilitate analysis and allocation of variances.	Join Fields between Files or Tables and Selecting, Sorting, and Summarizing Data and Calculated Fields

Payroll - Employee Information Management

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Employee information is accurately reflected in the employee information database.	Identify changes to employee master file for supervisory review, e.g., additions, deletions, pay rate changes, etc.	Exception Reporting

Payroll - Payroll Processing

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Payroll processing is timely and accurate.	Select payments for supervisory review based on dollar amount, specific attributes, or random sample.	Selecting, Sorting, and Summarizing Data
	Identify multiple payments to one employee (potential duplicates).	Selecting, Sorting, and Summarizing Data
	Calculate average pay per employee for weekly/monthly trend analysis.	Selecting, Sorting, and Summarizing Data
	Identify payments to new or terminated employees for supervisory review.	Exception Reporting
	Identify individual payments to salaried employees with variance from prior pay periods.	Exception Reporting

Travel - Authorization

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
All official travel is properly authorized in accordance with applicable laws, regulations, and management's policy.	Analyze travel orders for instances of travel not authorized in accordance with applicable laws, regulations, and management's policy.	Selecting, Sorting, and Summarizing Data
All travel transactions are recorded in a systematic order.	Identify instances of travel paid but not authorized.	Exception Reporting
	Identify travel advances/vouchers that are authorized after payment.	Exception Reporting
All travel information is accurately reflected in the system.	Verify that traveler's personnel information (e.g., staff ID, SSN, payment address, permanent duty station, etc.) is retained by the system.	Compare/Match Two Files or Tables
	Verify that changes made to the system (e.g., traveler information, budgetary limits, etc.) are in accordance with management's policy.	Exception Reporting

Travel - Advances

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Authorized travel advances are within budgetary limits.	Reconcile travel advances to authorized appropriations on a quarterly basis.	Selecting, Sorting, and Summarizing Data
	Determine extent of over obligations and over expenditures.	Join Fields between Files or Tables and Selecting, Sorting, and Summarizing Data
Travel advances are made only once and to the appropriate party.	Identify duplicate transactions or document numbers.	Gap Detection and Duplicate Detection
	Reconcile travel advances to the appropriate authorizing and payment documents.	Join Fields between Files or Tables and Selecting, Sorting, and Summarizing Data

Travel - Travel Voucher

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Amounts claimed are in accordance with authorized laws, regulations, and management's policy.	Determine whether the per diem, mileage allowances, and standard mileage are accurately reflected in the database.	Exception Reporting
	Compare amounts claimed on the payment voucher to the database of per diem, mileage allowances, standard mileage, etc.	Selecting, Sorting, and Summarizing Data and Exporting Data
Amounts claimed are valid and within authorized limits.	Identify invalid claims and instances where amounts claimed exceed established limits.	Exception Reporting
	Recalculate actual amounts claimed on the travel voucher and compare to established limits.	Selecting, Sorting, and Summarizing Data and Calculated Fields

Travel - Status

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Overdue travel advances are recorded by the agency's accounts receivable system.	Reconcile overdue travel advances recorded by the travel system to the agency's accounts receivable system.	Join Fields between Files and Tables and Selecting, Sorting, and Summarizing Data
	Identify any overdue travel advances with no scheduled collection date.	Exception Reporting
	Identify instances of overdue travel advances not established as an accounts receivable.	Exception Reporting
	Summarize all overdue travel advances by traveler name and due date.	Selecting, Sorting, and Summarizing Data
Amounts authorized are both timely and accurate.	Identify number and dollar value of outstanding travel advances over 60 days old, 90 days old, etc.	Selecting, Sorting, and Summarizing Data
	Recalculate authorized per diem, meals and incidental expenses based on itinerary and actual travel performed.	Selecting, Sorting, and Summarizing Data and Calculated Fields
All travel transactions are accurately reflected in the core financial system.	Reconcile travel advances obligations and payments.	Compare/Match Files or Tables; and Selecting, Sorting, and Summarizing Data; Join Fields between Files and Tables

Direct Loan Management - Loan Extension

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Applicants are evaluated (accepted/rejected) according to specified guidelines	Compare applications against eligibility and credit-worthiness criteria to determine if acceptance/rejection complied with established guidelines	Selecting, Sorting, and Summarizing Data and Compare/Match Files or Tables
	Identify historical results of individual credit officers to evaluate underwriting decisions	Selecting, Sorting, and Summarizing Data
	Obtain loan application demographic data for management reporting.	Selecting, Sorting, and Summarizing Data
Lending is maintained within legal funding limits.	Identify loans individually, or in the aggregate for single borrowers, that exceeded allowed borrowing levels.	Compare/Match Files or Tables
	Identify loans that are not posted to both the loan and funds control system.	Exception Reporting

Direct Loan Management - Account Servicing

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Loan systems contain adequate and current information.	Recompute loan balances based on disbursement and payment history to ensure the system is correctly posting transactions and calculating balances and escrows.	Selecting, Sorting, and Summarizing Data, and Calculated Fields
	Recompute billings and statements to ensure that they are accurately prepared by the system.	Selecting, Sorting, and Summarizing Data, and Calculated Fields.
	Identify loans with credit balances.	Exception Reporting
Modified loans are properly approved and presented.	Identify modifications made to loan terms for management scrutiny.	Compare/Match Files or Tables
Identification of past-due accounts are made in a timely fashion.	Determine if loan status (e.g., delinquent, in repayment, etc.) is consistent with payment history.	Selecting, Sorting, and Summarizing Data, and Join Fields between Files and Tables

Direct Loan Management - Portfolio Management

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Portfolio performance measures are needed to evaluate program performance.	Obtain statistical and demographic data on loan portfolio.	Selecting, Sorting, and Summarizing Data
	Obtain loan data by cohort to facilitate Credit Reform reporting.	Selecting, Sorting, and Summarizing Data
Loan data are required to support loan sales.	Select loans from the portfolio for sale based on specified loan characteristics.	Selecting, Sorting, and Summarizing Data, and Calculated Fields
Portfolio information is properly valued and allowances are disclosed.	Prepare aging of accounts and perform collateral analysis to help calculate allowance for the portfolio.	Aging Data and Calculated Fields

Direct Loan Management - Delinquent Debt Collection

Data Integrity Objectives	Illustrative Monitoring Techniques	Suggested Monitoring Tools
Recovery of delinquent debt is accomplished in a timely fashion.	Determine whether required collection actions were taken on delinquent loans in accordance with the Office of Management and Budget's debt collection requirements.	Selecting, Sorting, and Summarizing Data
	Prepare trend analysis of defaults and recoveries to determine the effectiveness of debt collection techniques.	Selecting, Sorting, and Summarizing Data
Unrecoverable debts are written off in a timely fashion.	Analyze accounts and the aging of receivables and confirm that amounts overdue over the stipulated amount of time are properly expensed.	Selecting, Sorting, and Summarizing Data, and Aging Data

Appendix B. Preventive Controls 7

The Monitoring Module tools discussed in this report and in Appendix A are feedback or detective controls. As stated earlier, preventive controls are crucial as a first line of defense in any financial system. Preventive controls should prevent erroneous data from being entered into the system. Two preventive controls found in financial systems are discussed in this appendix.

Edit and Limit Checks

Edit and limit checks, already included in many financial systems, are also included in the functional requirements published by JFMIP. In using this control, reasonable edit and limit checks are established as the system is implemented. Data are compared to these checks and limits as they are entered. If the data fail the tests, the user must take appropriate action to correct the problem. The issues of user interface and implementation of edit and limit checks are important enough for some coverage in this report. Preventive control can also be provided through the use of pick lists. Pick lists are lists of items such as accounts or vendors that can be chosen by clicking on the item, eliminating the need to key the information and reducing the chance for keyboard errors.

Financial systems should contain a set of edit and limit checks to ensure data integrity within the system. If the system is currently being implemented, the computer technology for designing these edit and limit checks is simple. Edit and limit checks can also be added to existing systems, but for some systems this may be difficult and costly. A greater challenge is determining where and how to implement the edit and limit checks. The solution will probably be different in each situation. In an organization with uniform divisions, the financial system developer can probably implement the solution at a central point in the organization. However, in a very diverse organization, implementation will probably be required for each division. Usually a combination of these two methods will work best. Organizations do things similarly in some areas, such as travel.

Most of the edit and limit check configuration could be performed for an entire organization in such cases, with minor changes needed for some divisions. These changes will be most effective if they are developed with the help of the division personnel who will use them. In all cases, the help of an audit organization is essential. In the case of the Federal government, the Office of Inspector General should probably be involved.

It is important that the user interface for setting and changing edit and limit check parameters be easy for authorized personnel to operate. A possible implementation of the user interface would automatically allow the user (through the use of a user profile that identifies the person and the work area) to use a spreadsheet type of screen to set all the data entry fields for that area of the organization.

Digital Signatures

Federal Information Processing Standards (FIPS) 186, Digital Signature Standard (DSS) [10], was issued May 19, 1994, and became effective December 1, 1994. The trend of many Federal government agencies to transform paper-based systems into automated electronic systems has created the need for a reliable, cost-effective digital signature system. A digital signature can be used to identify and authenticate the originator of information. Digital signatures can also be used as follows:

- To verify that information has not been altered after it is signed
- To ensure that transactions coming electronically from another part of the accounting system are authentic, authorized transactions
- To ensure that proper separation of duties is maintained.

The verification provided by digital signatures includes not only the name of the person authorizing the transaction but also relevant transaction data. Any change in either the name or the data can be detected.

Appendix C. Integrated Test Facility 8

The Integrated Test Facility (ITF) allows test data to be used safely to evaluate the system controls and processing in a live production environment. The ITF is used to test the following:

- Edit and limit checking and verification criteria
- Database updates and security features (such as transaction rollbacks)
- Computer generated transactions
- Output.

In addition, the ITF can be used to evaluate system performance by monitoring test transactions as they are processed.

The Integrated Test Facility can be integrated into the financial system in a way that can improve the safety of using the tool by sending data only to a "dummy database." This would ensure that test transactions do not get mixed with live transactions. Security protection should prevent all but authorized personnel from using this tool.

The Integrated Test Facility provides a safe way to test the effectiveness of the Monitoring Module tools and other system controls. The user can enter and process selected test transactions and live data concurrently in a live production system, tracing the flow of transactions through the various functions in the system and comparing the results of the test transactions with predetermined or precalculated results. The ITF requires a dummy entity (e.g., division, store, dealer) integrated into the normal production system. Once this fictitious entity has been established, transactions can be processed against it using the standard production input process.

All transaction types, combination of types, logic paths, computations, and controls within the application can be tested by this method at any time.

When using an ITF, additional controls must be established to ensure that test data are not posted to live production records. For example, all test data must be keyed to or identified with a fictitious entity by using a unique identification code. In addition, special procedures must be established to (1) ensure that test data are not included in final output reports and accounting records and (2) prevent test data from being communicated to other applications. These additional procedures require the following:

- Modification of existing programs to separate test data from live production data

- Deleting test data and manually adjusting all totals and reports to remove transactions

- Designing the application so it can process, but keep separate, both test data and normal production data.

Ideally, an ITF is established during the initial design of an application process. This eliminates the cost of later modifying programs, and reduces manual intervention for removing transactions from production files. However, the ITF can be implemented after the application is operational in a production environment [3]. The accuracy of automatically generated transactions can be tested by the ITF. Furthermore, there may be a desire to test transactions calculated based on standing data in the system each time there are wide-spread changes. Most importantly, an ITF can be used by management, users, software developers, modification personnel, quality assurance personnel, and auditors.

Implementing an ITF in a new system built with relational database technology is straightforward. When the ITF is in use, data go to a test database. These data could have test balances established for all general ledger accounts. Test data would go only to this database but would use the file structure and programming instructions of the actual financial system. Test data would never go to the live database with actual transactions.

Adding an ITF to an established system is more of a problem and can require almost an entire system redesign. John Lainhart and Barry Snyder in their article *A Simultaneous Parallel Approach to Testing Computerized Systems* [11], describe a method that allows an ITF to be added to an existing system with little program modification. Two modules of programming code are added to the existing program. One splits test transactions from live transactions, and the other merges them back together. These modules look for a certain code to be present in a record that indicates that transactions are test transactions. It is also possible to add a menu choice to select the ITF for use, just as with a new system. The user interface may or may not be as user friendly, but the capability can still be there. These transactions are split and the live transactions go to create a new master file used for reporting. The merge module is then used to merge test transactions with live transactions to create a new master file.

Only authorized, properly trained personnel should use the ITF. The new system, with a built-in ITF, should be easy to use. System designers who build the ITF into existing systems should make every effort to provide as much ease of use and safety as possible in their implementation. Each implementation will be different, and implementation and safeguarding methods are left to the system designer. It is important that management completely understands how the ITF works and how it will be implemented, that there be complete and clear documentation describing ITF implementation and operation, and that system design professionals be used to ensure safe operation.

Appendix D. Monitoring Module Tools - Examples and Samples 9

Exception Reporting

- Payments that are not made in a timely manner
- Payments that are legal but are for a high dollar value (these may be correct, but management might want to review them)
- Travel transactions for all employees who received an advance of $1,000 or more
- Travel transactions for all employees with travel claims that have been outstanding for longer than a given period
- Travel transactions where the payment of transportation costs exceeds the transportation costs authorized
- All equipment items that have not been inventoried in the last year
- All accounts receivable items authorized to exceed the established credit limit
- All accounts receivable items with an amount over $25,000
- All accounts with balances that are older than acceptable
- Large payments to the same vendor
- Transactions for single vendors with multiple points of payment
- Possible duplicate payments - transactions with the same vendor and same amount

Some of the above could also be subjects of ad hoc reports produced by the Selecting, Sorting, and Summarizing tool. The distinction between Exception Reporting and Selecting Records is the frequency with which they are used. Exception reporting is used in areas where you expect problems. Selecting records is used to determine whether there are problems in other areas. If problems are regularly found in a certain area by selecting records, this area may be a candidate for exception reporting.

Figure 1. Accounts Payable Transaction File.

Vendor	Date	Amount
Smith Office Machines	1/12/95	$10,950.00
Jones Meats Inc.	1/12/95	1,500.00
Harley Temps	1/12/95	1,200.00
Johnson Office Furniture	1/12/95	12,000.00
Smith Office Machines	1/14/95	28,500.00
Smith Office Machines	1/20/95	128,000.00
Jones Meats Inc.	2/1/95	1,250.00
Harley Temps	2/1/95	1,250.00
Jones Meats Inc.	2/13/95	1,450.00
Jones Meats Inc.	2/14/95	850.00
Harley Temps	2/14/95	1,400.00
Johnson Office Furniture	2/14/95	1,250.00
Smith Office Machines	2/23/95	2,750.00

Figure 2. Selected Records from the Accounts Payable Transaction File where Vendor equals "Smith Office Machines."

Vendor	Date	Amount
Smith Office Machines	1/12/95	$10,950.00
Smith Office Machines	1/14/95	28,500.00
Smith Office Machines	1/20/95	128,000.00
Smith Office Machines	2/23/95	2,750.00

Vendor	Date	Amount
Smith Office Machines	1/12/95	$10,950.00
Smith Office Machines	1/14/95	28,500.00
Smith Office Machines	1/20/95	128,000.00

Figure 3. Selected records from the Accounts Payable Transactions File where Vendor equal "Smith Office Machines" and Date is equal to or greater than 1/1/95 and less than or equal to 1/31/95.

Record selection:

- List authorized account balances greater than $100 in excess of credit limits
- List all cash disbursements between two dates (this list could then be used to verify the disbursements to actual documents)
- List accounts receivables over a specified dollar amount and past-due more than a specified number of days
- List all benefit claimants who filed before, after, or between certain dates.

Examples of Sorting Data

Figure 4. Data before the sort.

Vendor	Date	Amount
Smith Office Machines	1/12/95	$10,950.00
Jones Meats Inc.	1/12/95	1,500.00
Harley Temps	1/12/95	1,200.00
Johnson Office Furniture	1/12/95	12,000.00
Smith Office Machines	1/14/95	28,500.00
Smith Office Machines	1/20/95	128,000.00
Jones Meats Inc.	2/1/95	1,250.00
Harley Temps	2/1/95	1,250.00
Jones Meats Inc.	2/13/95	1,450.00
Jones Meats Inc.	2/14/95	850.00
Harley Temps	2/14/95	1,400.00
Johnson Office Furniture	2/14/95	1,250.00
Smith Office Machines	2/23/95	2,750.00

Figure 5. Data after sorting by Vendor and then Date.

Vendor	Date	Amount
Harley Temps	1/12/95	$1,200.00
Harley Temps	2/1/95	1,250.00
Harley Temps	2/14/95	1,400.00
Johnson Office Furniture	1/12/95	12,000.00
Johnson Office Furniture	2/14/95	1,250.00
Jones Meats Inc.	1/12/95	1,500.00
Jones Meats Inc.	2/1/95	1,250.00
Jones Meats Inc.	2/13/95	1,450.00
Jones Meats Inc.	2/14/95	850.00
Smith Office Machines	1/12/95	10,950.00
Smith Office Machines	1/14/95	28,500.00
Smith Office Machines	1/20/95	128,000.00
Smith Office Machines	2/23/95	2,750.00

Vendor	Date	Amount
Harley Temps	1/12/95	$1,200.00
Harley Temps	2/1/95	1,250.00
Harley Temps	2/14/95	1,400.00
Johnson Office Furniture	2/14/95	1,250.00
Johnson Office Furniture	1/12/95	12,000.00
Jones Meats Inc.	2/14/95	850.00
Jones Meats Inc.	2/1/95	1,250.00
Jones Meats Inc.	2/13/95	1,450.00
Jones Meats Inc.	1/12/95	1,500.00
Smith Office Machines	2/23/95	2,750.00
Smith Office Machines	1/12/95	10,950.00
Smith Office Machines	1/14/95	28,500.00
Smith Office Machines	1/20/95	128,000.00

Figure 6. Data sorted by Vendor and then Amount.

Vendor	Date	Amount
Smith Office Machines	2/23/95	$2,750.00
Smith Office Machines	1/12/95	10,950.00
Smith Office Machines	1/14/95	28,500.00
Smith Office Machines	1/20/95	128,000.00

Figure 7. Data selected from the Accounts Payable Transaction File where Vendor equals "Smith Office Machines" and then sorted by Amount.

Sorting examples:

Sort inventory items by location to facilitate physical observations.

List all account balances more than $100 in excess of credit limits and sort in descending order according to the size of the excess.

Examples of summarizing files

Figure 8. Accounts Payable Transaction File.

Vendor	Date	Amount
Smith Office Machines	1/12/95	$10,950.00
Jones Meats Inc.	1/12/95	1,500.00
Harley Temps	1/12/95	1,200.00
Johnson Office Furniture	1/12/95	12,000.00
Smith Office Machines	1/14/95	28,500.00
Smith Office Machines	1/20/95	128,000.00
Jones Meats Inc.	2/1/95	1,250.00
Harley Temps	2/1/95	1,250.00
Jones Meats Inc.	2/13/95	1,450.00
Jones Meats Inc.	2/14/95	850.00
Harley Temps	2/14/95	1,400.00
Johnson Office Furniture	2/14/95	1,250.00
Smith Office Machines	2/23/95	2,750.00

Figure 9. Accounts Payable Transaction File Summarized by Vendor.

Vendor	Date	Amount
Harley Temps	1/12/95	$1,200.00
Harley Temps	2/1/95	1,250.00
Harley Temps	2/14/95	1,400.00
Total for Harley		$3,850.00
Johnson Office Furniture	1/12/95	$12,000.00
Johnson Office Furniture	2/14/95	1,250.00
Total for Johnson		$13,250.00
Jones Meats Inc.	1/12/95	$1,500.00
Jones Meats Inc.	2/1/95	1,250.00
Jones Meats Inc.	2/13/95	1,450.00
Jones Meats Inc.	2/14/95	850.00
Total for Jones		$5,050.00
Smith Office Machines	1/12/95	$10,950.00
Smith Office Machines	1/14/95	28,500.00
Smith Office Machines	1/20/95	128,000.00
Smith Office Machines	2/23/95	2,750.00
Total for Smith		$170,200.00
Total for Accounts Payable		$192,350.00

Vendor	Date	Amount
Jones Meats Inc.	1/12/95	$1,500.00
Total Jones for January		$1,500.00
Jones Meats Inc.	2/1/95	$1,250.00
Jones Meats Inc.	2/13/95	1,450.00
Jones Meats Inc.	2/14/95	850.00
Total Jones for February		$3,550.00
Total for Jones		$5,050.00

Figure 10. Records selected where Vendor equals "Jones Meats Inc." from the Accounts Payable Transactions File Summarized by date.

Frequency Distribution Reporting

A cruise ship company could use frequency distribution on its automated master file to identify records having invalid codes in the License Code Field. The License Code field is a two-digit code used to represent a particular description. The following is a listing of possible results. The valid codes are identified with a legitimate description. Invalid codes are researched and the problems are identified.

Figure 11. Frequency Distribution.

Items	Count of Items	Description
(bl)	9	Data entry Error
G	1	Data entry Error
**	1184	Unknown
AA	39639	Master Deck Officer
AB	3897	Chief Mate Deck Officer
AC	4262	Second Mate Deck Officer
AD	7043	Third Mate Deck Officer
AE	6612	Mate Deck Officer
AF	14063	First Class Pilot Deck Officer
AG	11	Data entry error
AR	1	Data entry error
BA	16944	Chief Engineer Officer
BB	6013	First Assistant Engineer
BC	7769	Second Assistant Engineer
BD	16077	Third Assistant Engineer
BE	1474	Assistant Engineer
BF	171	Designated Duty Engineer
CA	2190	Radio Officer
DA	75	Surgeon Staff Officer
DB	31	Professional Nurse
DC	97	Chief Purser
DD	7	Chief Purser/PYA
DE	9	Chief Purser/HM
DF	66	Purser
DG	2	Purser/PYA
DH	2	Purser/HM
DI	20	Senior Assistant Purser
DJ	3	Senior Asst. Purser/PYA
DK	5	Senior Assistant Purser/HM
DL	147	Junior Assistant Purser
DM	2	Junior Assistant Purser/PYA
DN	22	Junior Assistant Purser/HM
DO	7	Medical Doctor
EA	47883	Kitchen
EB	1	Data entry error
FA	22308	Dining Room
GA	41325	Entertainers
HA	27938	Social Director
HB	1946	Second Class Operator
HZ	1	Data entry error
XX	1	Data entry error
ZZ	4231	Endorsement
5E	1	Data entry error
6B	2	Data entry error
6E	1	Data entry error
7B	1	Data entry error
9e	1	Data entry error

Items	Count of Items	% of Items	Mean	Std. Dev.
	9	0.00	1	0
G	1	0.00	1	0
**	1184	0.43	1	0
AA	39639	14.49	1	0
AB	3897	1.42	1	0
AC	4264	1.56	1	0
AD	7043	2.58	1	0
AE	6612	2.42	1	0
AF	14063	5.14	1	0
AG	11	0.00	1	0
AR	1	0.00	1	0
BA	16944	6.20	1	0
BB	6013	2.20	1	0
BC	7769	2.84	1	0
BD	16077	5.88	1	0
BE	1474	0.54	1	0
BF	171	0.06	1	0
CA	2190	0.80	1	0
DA	75	0.03	1	0
DB	31	0.01	1	0
DC	97	0.04	1	0
DD	7	0.00	1	0
DE	9	0.00	1	0
DF	66	0.02	1	0
DG	2	0.00	1	0
DH	2	0.00	1	0
DI	20	0.01	1	0
DJ	3	0.00	1	0
DK	5	0.00	1	0
DL	147	0.05	1	0
DM	2	0.00	1	0
DN	22	0.01	1	0
DO	7	0.00	1	0
EA	47883	17.51	1	0
EB	1	0.00	1	0
FA	22308	8.16	1	0
GA	41325	15.11	1	0
HA	27938	10.22	1	0
HB	1946	0.71	1	0
HZ	1	0.00	1	0
XX	1	0.00	1	0
ZZ	4231	1.55	1	0
5E	1	0.00	1	0
6B	2	0.00	1	0
6E	1	0.00	1	0
7B	1	0.00	1	0
9E	1	0.00	1	0

Figure 12. Frequency Distribution Report.

Stratification of a File or Table

Figure 13. The file has been divided into five segments with ranges specified to obtain information regarding each file segment.

Range	Lower Limit	Upper Limit
1	-250,000	0
2	0	250,000
3	250,000	500,000
4	500,000	750,000
5	750,000	1,000,000

Figure 14. Results from the set of ranges specified in Figure 13.

Range	Records	% of Records	Balance	% of Balance
1	0	0.00	0.00	0.00
2	53	53.00	7,934,982.89	27.20
3	28	28.00	8,609,006.63	29.51
4	18	18.00	11,865,982.93	40.67
5	1	1.00	765,000.97	2.62
Totals	100	100.00	29,174,973.42	100.00

Appendix E. Contributors to the Report 10

NIST formed a working group of accounting and auditing experts to develop a more complete set of Monitoring Module tools than discussed in the previous report on this subject. The following organizations were invited to attend and provide input to the report:

American Institute of Certified Public Accountants
Arthur Andersen & Co. L.L.P.
Coopers & Lybrand L.L.P.
Deloitte & Touche L.L.P.
Ernst & Young L.L.P.
Institute of Internal Auditors
Joint Financial Management Improvement Program
KPMG Peat Marwick L.L.P.
Office of Management and Budget
Price Waterhouse L.L.P.
United States Department of Defense, Defense Finance and Accounting Service
United States Department of Health & Human Services, Office of Inspector General
United States Department of Treasury, Financial Management Service
United States General Accounting Office
United States House of Representatives, Office of Inspector General
United States Securities and Exchange Commission

The following individuals made significant contributions to the report:

Ms. Jane E. Altenhofen, CIA, CFE	Institute of Internal Auditors
Mr. David T. Copenhafer	United States Securities and Exchange Commission
Mr. Stephen W. Greenfield, MBA, CGFM	U. S. Department of Health & Human Services, Office of Inspector General
Mr. Jonathan Korol, CPA	Deloitte & Touche L.L.P.
Mr. John W. Lainhart IV, CISA	United States House of Representatives, Office of Inspector General

Ms. Janet A. McLeod, CPA	U. S. Department of Health & Human Services, Office of Inspector General
Mr. Thomas F. Patterson, CPA, CISA	Coopers & Lybrand L.L.P.
Mr. Peter A. Salinger, CDP	KPMG Peat Marwick L.L.P.
Mr. Ray Sexton	U. S. Department of Defense, Defense Finance and Accounting Service
Mr. Stephen B. Watson, CPA, CIA, CMA, CGFM	Price Waterhouse L.L.P.
Ms. Linda Wilkinson	U. S. Department of Treasury, Financial Management Service
Mr. Chris Zoladz, CPA, CISA	Ernst & Young L.L.P.

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Glossary 11

attributes sampling

Statistical sampling that reaches a conclusion about a population in terms of a rate of occurrence.

data retrieval

Displaying specific records or groups of records identified by a set of criteria regarding file or database data.

dollar unit sampling

A variable sampling procedure that uses attributes theory to express a conclusion in dollar amounts.

expert system

Closely related to the concept of artificial intelligence, these systems assist in decision-making by bringing users the knowledge of experts[12].

exporting data

A process that allows data from one application to be automatically transformed for use in another application.

field

A category of information, such as a name.

file

A collection of data. A telephone book can be thought of as a file: each person in the telephone book has a record, each record contains a name field, an address field, and a phone number field.

generalized audit software

A computer program or series of programs that enable the auditor to directly access client computer data files, extract relevant data, and perform useful audit functions [13]. These packages include a series of computer programs that have been preprogrammed, thereby providing the power and flexibility of programming languages while requiring only minimal coding (using a high-level, problem-oriented language). These packages permit such functions as reading data, manipulating data, sorting data, and printing reports to be performed without programming languages. Generalized audit software programs can be coded, debugged, and executed in a fraction of the time it takes in common programming languages. Generalized audit software can be installed as microcomputer, minicomputer, or mainframe packages or as a combination of environments [3].

integrated test facility

The ITF functions as follows:

- Enter and process selected test transaction input along with live data in a live production system
- Trace the flow of transactions through the various system functions
- Compare test transaction results with predetermined results.

Entering test transactions through the ITF requires integrating a dummy entity into the normal production system. Once this fictitious entity has been established, transactions can be processed against it using the standard production input process [3].

module

A suite of tools that are logically located together. The tools are described in one section of the documentation. The menu selections for all the module tools are under one main menu selection in the user interface.

off-the-shelf software

Commercially available software that is not custom-designed for the organization.

query

Allows the user to ask questions and define a set of criteria about the data. The query is used to isolate specific records or groups of records for display or processing.

random sample

Every combination of the same number of items in the population has an equal probability of selection.

record

A collection of related items or field data, for example all the information regarding one entry in the telephone book.

relational database

A system using a data representation model based on tables, nonprocedural operations, and predicate logic [14].

report generator

A report generator allows automatic generation of pre-designed reports or allows ad-hoc reports to be defined. Some data manipulation functions may be performed, and data extraction is possible.

sample

Items selected from a population to reach a conclusion about that population.

table

A collection of data about a particular subject. It can be thought of as columns (fields) and rows (records).

tool

A set of software instructions designed to allow the user to easily enter needed information and then use the information to perform a task.

variables sampling

Statistical sampling that reaches a conclusion on the monetary amounts of a population.

References 12

[1] Sies, Roger F., *Self Monitoring Accounting Systems*, National Institute of Standards and Technology Special Publication 500-226, March 1995.

[2] Joint Financial Management Improvement Project, *Framework for Federal Financial Management Systems*, 1994.

[3] *Computerized Information Systems (CIS) Audit Manual*, The Information Systems Audit and Control Foundation, 1992.

[4] Federal Information Processing Standards (FIPS) 193, *SQL Environments,* FIPS Publication 193, U.S. Department of Commerce, National Institute of Standards and Technology, February 3, 1995.

[5] American National Standard for Information Systems (ANSI). Information Systems - *Database Language - SQL,* ANSI X3.135-1992, equivalent to International Standard ISO/IEC 9075:1992 and Federal Information Systems Processing Standard (FIPS) Pub 127-2, October 1992.

[6] The Institute of Electrical and Electronics Engineers, Inc., *Software Engineering Standards,* Third Edition 1989.

[7] Ruthberg, Zella G., Bonnie Fisher, William E. Perry, John W. Lainhart IV, James G. Cox, Mark Gillen, and Douglas B. Hunt, *Guide to Auditing for Controls and Security: A System Development Life Cycle Approach*, National Bureau of Standards Special Publication 500-153, April 1988.

[8] *Systems Auditability and Control Report,* The Institute of Internal Auditors Research Foundation, 1991.

[9] Joint Financial Management Improvement Project, *Core Financial System Requirements*, Interim Final, April 1994.

[10] Federal Information Processing Standards (FIPS) 186, *Digital Signature Standard (DDS),* FIPS Publication 186, U.S. Department of Commerce, National Institute of Standards and Technology, December 1, 1994.

[11] Lainhart, John and Barry Snyder, *A Simultaneous-Parallel Approach to Testing Computerized Systems*, EDPACS, October 1977.

[12] Coopers & Lybrand L.L.P., *Handbook of IT Auditing,* Warren, Gorham & Lamont, 1994.

[13] American Institute of Certified Public Accountants, *Auditing With Computers*, 1994.

[14] Schur, Steven G., *The Database Factory,* John Wiley & Sons, Inc., 1994.

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